

**The Knowledge Bank at The Ohio State University**  
**Ohio State Engineer**

**Title:** Electric Welding as Relates to Waste in Industry

**Creators:** Lincoln, James Finney, 1883-

**Issue Date:** Nov-1926

**Publisher:** Ohio State University, College of Engineering

**Citation:** Ohio State Engineer, vol. 10, no. 1 (November, 1926), 8, 13, 34-36.

**URI:** <http://hdl.handle.net/1811/33831>

**Appears in Collections:** [Ohio State Engineer: Volume 10, no. 1 \(November, 1926\)](#)

# ELECTRIC WELDING AS RELATES TO WASTE IN INDUSTRY

By J. F. LINCOLN, *Vice-President, Lincoln Electric Co., Cleveland, Ohio*

(From a Paper read at Management Week Convention)

MR. CHAIRMAN AND GENTLEMEN:



UNDERSTAND that all of you gentlemen are, almost without exception, students, and I have a fellow feeling for you, because I used to have to sit down and hear some of the old codgers who went to school before I did come back and tell what they were doing, so that you are sort of having a case of vicarious suffering for the sins of people who have gone before you.

I am going to talk to you about arc-welding as related to waste in industry. That is perhaps not as good a name as we might get for it, for the reason that arc-welding, as I am going to talk about it, is a new method in so far as its application is concerned, and will, in my opinion, entirely revolutionize the manufacture of many products.

We are at the present time in a period which has been heretofore unknown in the history of the world, where the cost of finished products is being reduced, and yet the cost of the raw material going into them and the wages of the men making them are at the same time increasing. It is a condition which has never been known before and is the result purely and simply of management: management in finding better methods of doing the same kind of work, better methods whereby it is possible to make a cheaper kind of material do for a more expensive kind; and management also in getting a greater production out of such material.

To show you something of this condition of decreased cost of finished product, with an increased tendency in cost of the raw materials and labor, I want to cite you to the case of the Ford car, which, ten years ago, sold for a thousand dollars. At that time they paid an average wage of 24 cents an hour for a ten-hour day; materials cost about two-thirds of what the raw materials cost now. Since that time, as I have indicated, wages have been increased from 24 cents an hour to 80 cents an hour; the raw material going into the machine has increased by about fifty per cent, which would indicate, other things being equal, that the price of a Ford car now should be \$4,500. As a matter of fact, this same Ford car which sold ten years ago for a thousand dollars, sells now for \$250. Remember, the car is the same, the design has changed but little, and, in so far as the difficulty of making the parts is concerned, it is identically the same car; yet the total cost has been reduced to a little more than five per cent of what it would have been at this time.

To say that that is the result of automatic machinery, mass production, or whatever you will, is partially true; but the real facts are that it is the result of management. It is the result of finding better methods for doing the same thing, the finding of better materials or cheaper materials to do the same job equally well, and the finding of methods whereby the output per man-hour is increased enormously.

It is a fact that there are very few things which, if you have enough of them to make, you cannot reduce in labor cost and material cost, just as far as you wish. Given enough of them, you can practically eliminate the

labor cost entirely. The Ford car is an outstanding example because it is one of the very few things which is being manufactured now in about the same form that it was manufactured ten or twelve years ago. That is the reason the Ford car is reduced in price. There are very few other machines of any kind which are of the same type and design and layout as they were ten years ago.

Let us consider the thing from the point of view of what it is that goes in to make up the cost of any piece of apparatus. It is easily divided into three parts.

First is the material cost. By that I mean the raw material which the manufacturer of the finished product buys. Generally that is the finished product of the supplier. It may be the product of the supplier is again furnished to him as the finished product of some other supplier. But let us call the raw material whatever he buys and changes into another form in order to make up the piece of apparatus that he has to make. That, in the case of an average manufacturing company, we will say, will be 35 per cent of the selling price.

Next to that is labor cost, that which he actually pays to his productive men for doing the work. That will average seven and one-half per cent of the selling price.

Then we have what is called the shop overhead, which includes in some factories things that it does not include in other factories, but which will average about twelve per cent of the selling price.

In those three items you will have somewhere near 55 per cent of the selling price as the cost. I think that that is a fair and accurate statement of the cost of manufacture of the average machine by the manufacturer who is making a fairly good margin of profit. On top of that must come the selling expense, the designing expense, and the profit.

It may be interesting to know that the cost of distribution has increased enormously in the last ten years. That is interesting, but has nothing to do with this discussion. I do want to say, however, that I think the next great advance in manufacturing is going to be in a better method of distribution. By that I mean that the man who has the brains and the gumption and the ability to find a more economical way of distributing products will be the great man of the future so far as manufacturing is concerned.

I do not want to leave that without saying one thing more. I think it is safe to say that for everything you buy, out of every dollar you pay for it, you will pay at least fifty cents to have it sold to you, and in a great many cases much more.

I will just give you one example of that, something which you come in contact with almost every day—washing machines, electrical washing machines. You pay \$150 for them. It may be interesting to you to know that in general the manufacturer of that washing machine gets \$45 for it, while the customer pays \$150 for it.

Let us take up these items which make up the manufacturing cost. It is self-evident that if you in any way are able to reduce your labor cost by 50 per cent, you are going to save on the selling price something less than four per cent. Reducing your man-hours by 50 per

(Continued on Page 13)

ELECTRIC WELDING AS RELATES TO  
WASTE IN INDUSTRY

(Continued from Page 8)

cent on a job is quite a task, but as far as the selling price on the apparatus goes, you have reduced it but four per cent. If you should find some outstanding scheme whereby your overhead could be reduced 50 per cent,—which would be a miraculous thing to do,—you will reduce the selling price but six per cent.

But if you can reduce the 35 per cent of raw material going into that by even ten per cent, you will make a saving fully as much as cutting your labor in half. It is self-evident, therefore, that the big advance in the future in manufacturing, as it has been in the past, is purely and simply a method of finding out how you can change your material or get other materials which will take the place of the ones you have and get them at a lower cost.

There is not much that can be done, comparatively speaking, in working with your labor and your overhead. If the same amount of ability, imagination and brains is put into reducing the material cost, the result will be far greater savings than the same amount of brains and ingenuity used in reducing the labor cost.

Therefore, I think it is safe to say that the men in the laboratories and the engineers of all manufacturing concerns are now spending much more time and energy in the reducing of their material costs than they are on any other item.

As an example, take the automobile again. Comparing the present-day automobile with the automobile of ten years ago, you will find that the bodies instead of being made of wood are made of pressed steel. The old fenders used to be made of leather. They are now made of pressed steel. A great many castings have been replaced by forgings. A great many iron castings have been replaced by malleable iron, and there are a number of other changes.

I think the most outstanding case that I can cite of using a cheaper material for taking the place of one that is expensive is the use of paper money to take the place of gold, where, of course, the saving is a very large proportion of the total.

The thing I want to talk to you about in the matter of saving materials is the replacement of castings by the use of structural steel. Structural steel has a strength of approximately 50,000 pounds, compared to cast iron with a strength of 10,000 pounds. It has a modulus of thirty million, as compared with twelve million in cast iron.

Let us put that into an actual piece of apparatus which is manufactured by our company, to show just what it means. Take the case of an ordinary base for a motor generator set. We have a case in point where we used to make a base out of cast iron with a weight of one thousand pounds. That is now being replaced by steel with a weight of four hundred pounds. The four-hundred-pound steel base is a little bit stiffer. It is absolutely unbreakable. But in the first cost, comparing the casting to finished steel base, it runs sixty dollars in the case of the cast iron as against twelve dollars in the case of the steel. In the case of the cast iron, you must machine it, you must plane the surface where you are going to put on the motor and generator. In a number of cases the bottom must even be planed in order to get the base level enough so that when it is placed on the floor it will not warp. In the case of the steel, however, it is already flat. Generally, all that it is necessary to do is to shim it as would be necessary in any case without any machining whatsoever. Let us take the machining cost of this cast iron base at fifteen dollars, making the

(Continued on Page 34)

## ELECTRIC WELDING AS RELATES TO WASTE IN INDUSTRY

(Continued from Page 13)

total cost of that base machined seventy-five dollars, against twelve dollars for the steel base.

Also the cast iron base requires a pattern. To make the pattern you must have a drawing. The pattern will cost you at least another fifteen dollars. The drawings will cost you something. But let us balance off the drawing against the sketch which is necessary in the other case. There you have ninety dollars against twelve dollars for the base in the same shape, ready to be used.

That is not an unusual condition at all. It is undoubtedly where the saving is perhaps outstanding, but it is indicative of the same saving which can be made in almost anything else.

That is not an unusual condition at all. It is undoubtedly where the saving is perhaps outstanding, but it is indicative of the same saving which can be made in almost anything else.

Now you may say, and justly, here is a case of a base where steel is easily applied, which is perfectly true. Then let us take a case where it is not so easily applied. Let us take the case of a wheel fourteen inches in diameter for a standard shop truck, designed to support a weight of approximately a thousand pounds. The cast iron wheel will weigh twenty-five pounds. It will cost one dollar and fifty cents to cast. The steel wheel will weigh twelve and one-half pounds. It is unbreakable. It will cost twenty-five cents. But in one case you have a completely formed casting and in the other case you have merely the metal that is used in making up the steel wheel. It will cost in our own factory fifteen cents to bend, weld in the spokes and the hub. In other words, you have in one case a cost of forty cents against one dollar and fifty cents. But in the case of the steel wheel, all you need to do is to broach a piece of pipe which can be used for the hub, which will cost a cent. The total cost, finished, is forty-one cents. In the other case, you are going to take a casting in the machine at a cost of fifteen cents, with a total cost of a dollar and sixty-five cents. There you have the two pieces of apparatus in exactly the same shape, the steel being very much better. It is lighter and stronger and absolutely reliable. The cast iron is much heavier, brittle and not nearly so reliable. There is a case where you cannot buy the section off the shelf in case you want it. But you can for a very, very small amount of money, make a change which will still give you the completed product at a fraction of the cost.

Let us take next the common steam boiler. In that case you use a sheet, wind it up into a circle, put in a double row of rivets, and you have a boiler, after you

have done a lot of caulking. In the other case, you would take this same sheet, wind it up into a circle, bring the two ends together and weld them. In the case of the riveted boiler, the joint is seventy per cent as strong as the sheet. By the welding, one hundred per cent strength in the joints can be obtained.

What does this mean? With the riveted construction, half again as much metal must be put in in order to bring the strength of the joint up to the point where it will give the same strength as the container. Therefore, each one of the boilers is going to weigh fifty per cent more than it needs to, on account of the weakness in the joint, which cannot be helped. It is self-evident in that case that one-third of the material going into the boiler is not needed.

Let us take another illustration, where there is more publicity, although there is less real need or real use for it, than in these other cases I have mentioned. That is the use of welded steel in buildings. It would be a tremendously important matter, were it true, that in general the pieces of steel in a welded building would fail because of failure in the joint. They do not fail for that reason. In general they fail from buckling, which has nothing to do with the strength of the joint, so that in that case the strength of the weld has very little advantage over the riveted construction. However, there are a number of advantages.

In the first place, there is no layout. In the second place, the assembling of welded construction is very, very much easier. And in the third place, the thing which I think is going to bring it into use rather than the economies, is the fact that there is no noise. I happen to know that there is a building going up near the Hotel Astor, in New York, which the proprietor of the hotel says will cost him a half million dollars because of the noise, which will drive patronage away from his hotel. That, I think, is the thing which is going to bring arc-welding into present-day building structures rather than the economies.

The buildings which have been put up, and there have been a number of them, have shown an economy in excess of twenty-five per cent. Let us make that point clear. I do not mean when you include the steel work there is a saving, but in the labor cost of fabrication and erection there is a saving of twenty-five per cent. The steel, of course, in both cases would be identically the same, because it is not the strength of the joint, but the resistance to buckling. That is the determining factor in buildings.

Now, how does this all apply to you as coming engineers, and what is your job in connection with it? It would seem to me there are two things.

(Continued on Page 36)

OHIO STATE ENGINEER,  
Ohio Union Building,  
Ohio State University,  
Columbus, Ohio.

Enclosed find One Dollar (\$1.00) for one year's subscription for the OHIO STATE ENGINEER.

Name \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Students  
Alumni

SERVING HIS EXCELLENCY  
*—The ENGINEER—*

**Pen Hospital**

We Repair all makes  
 twenty-four hour service.

**Rider's Pen Shop**

1836 North High Street  
 At the College Book Store

**BLOCK'S**  
*University Florist*

*Just Around the Corner at 16th Ave.*

ENGINEERING HANDBOOKS  
 REFERENCE BOOKS  
 DRAWING MATERIALS

ALL SUPPLIES FOR THE ENGINEER

**Long's College Bookstore**

TWENTY-FIVE YEARS OF SERVICE

*College and  
 Commercial Printing*

*Artcraft  
 Printing Company*

*1137 North High St.  
 UN. 2987*

**ROSE MARIE SHOPPE**

1392 NORTH HIGH STREET

Where Delicious Food Is Delightfully Served

OPEN FROM SIX A. M. TO TWO A. M. EVERY DAY

### ELECTRIC WELDING AS RELATES TO WASTE IN INDUSTRY

(Continued from Page 34)

In the first place, like any new process, the methods of application are in the development stage and will be in the development stage for years to come. What you should do is to know what the process will do, what its possibilities are, and to develop the technique of the methods of applying it.

What you should do, secondly, is to make sure that you are not bound by tradition, that you follow logic rather than custom in the considering of these matters. The future, as to when it will be done, depends upon men such as yourselves. The economic force which is driving us in the direction of its application will carry us there regardless of what we do. But it will be tremendously to the advantage of today's engineers if they will take this new process, see its possibilities, and develop them.

---